

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic			Area		Total area for each day	
		Diff. long.	Longi- tude	Lati- tude	Spot	Group		
1928—Continued								
July 31 (Naval Observa- tory).	<i>h.</i>	<i>m.</i>	°	°	°			
	11	42	-43.5	98.1	+7.5		170	
			-43.0	98.6	-14.5	3		
			-42.5	99.1	-25.0	31		
			-35.5	106.1	-15.5	46		
			-34.5	107.1	+13.0		15	
			-6.0	135.6	+14.0		370	
			+1.0	142.6	+13.0	370		
			+1.5	143.1	-20.0		31	
			+9.9	151.1	-20.0		37	
			+25.5	167.1	+7.0		37	
			+30.5	172.1	+7.0		62	
			+65.0	206.6	+13.5	108		1,280
	Mean daily area for July							1,434

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR JULY, 1928

[Data furnished by Prof. A. Wolfer, University of Zurich, Switzerland]

July	Relative numbers	July	Relative numbers	July	Relative numbers
1	125	11	69	21	127
2	135	12	127	22	114
3	133	13	131	23	77
4	88	14	132	24	54
5	59	15	149	25	60
6	52	16	145	26	66
7		17	133	27	66
8	97	18	118	28	76
9	91	19	124	29	98
10	85	20	129	30	97
				31	105

Number of observations, 30; mean, 101.2.

AEROLOGICAL OBSERVATIONS

By W. R. STEVENS

Free-air temperatures for July were slightly below normal at Ellendale and Groesbeck, but were slightly above at the other kite stations.

There were no important departures from the normal relative humidity at levels where observations were frequent enough to give reliable monthly means.

Vapor pressures were quite generally above normal, except for the higher levels at Ellendale, Groesbeck, and Royal Center.

Wind resultants as determined from pilot balloons were almost entirely of southerly component near the surface, but at the majority of the stations shifted gradually to northerly component with altitude. The base of the antitrades was reached on a few occasions at San Juan, the altitude ranging between 5,000 and 9,000 meters. Easterly winds at high levels were observed at a number of stations in the Northwest from the 19th to the 25th. As is usual in conditions of this kind, there was a lack of cyclonic activity over that section. A double-theodolite pilot-balloon observation at Ellendale on the afternoon of the 12th showed fairly strong convectional currents from the surface to the point where it entered cumulus

TABLE 1.—Free-air temperatures, relative humidities and vapor pressures during July, 1928—Continued

RELATIVE HUMIDITY (%)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters)	
	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal
Meters												
Surface	73	+4	72	+6	72	+3	84	+9	66	+4	67	-5
250	73	+4	73	+7	72	+4	85	+9	66	+4	70	-3
500	74	+8	76	+8	72	+4	83	+6	65	+1	65	-4
750	71	+7	73	+4	70	+6	72	0	69	+3	61	-6
1,000	63	0	72	+2	70	+8	63	-4	71	+3	61	-4
1,250	57	-6	73	+2	70	+10	59	-5	72	+4	64	-2
1,500	57	-5	73	+2	68	+10	55	-7	68	+1	66	-1
2,000	53	-6	73	+2	59	+4	51	-8	61	-2	70	+2
2,500	51	-7	74	+4	57	+4	51	-7	60	+3	62	-4
3,000	55	-3	68	0	52	+1	46	-11	32	-19	35	-25
3,500	55	-2	69	+1	49	-1	40	-17	30	-18		
4,000	56	-1			41	-9	36	-24	28	-15		
4,500	60	+7			40	-10	36	-5				

VAPOR PRESSURE (mb.)

Surface	26.39	+2.36	24.94	+1.77	18.23	+1.12	26.51	+0.88	21.04	+1.55	27.06	+4.20
250	26.17	+2.35	24.68	+1.84			25.71	+0.96	20.75	+1.54	23.41	+2.84
500	23.63	+2.68	22.35	+1.97	17.66	+1.12	23.24	+0.76	18.01	+1.00	19.63	+1.79
750	21.13	+2.33	19.98	+1.30	15.34	+0.99	19.27	-0.37	16.68	+1.10	17.26	+1.26
1,000	18.05	+0.99	17.99	+0.76	13.91	+1.06	15.93	-1.07	15.16	-0.79	15.63	+1.15
1,250	15.33	-0.10	16.45	+0.60	12.64	+1.11	13.73	-1.28	13.45	-0.48	14.59	+1.31
1,500	13.91	+0.04	14.88	+0.56	11.22	+0.92	11.87	-1.60	11.38	-0.17	13.36	+1.08
2,000	10.76	-0.23	12.26	+0.58	8.21	-0.08	9.21	-1.74	8.11	-0.74	11.39	+1.20
2,500	8.54	-0.29	10.17	+0.79	6.41	-0.31	7.66	-1.35	5.90	-0.59	8.72	+0.50
3,000	7.51	+0.30	7.83	+0.26	4.87	-0.54	6.01	-1.58	3.06	-1.81	4.98	-1.25
3,500	6.35	+0.42	6.60	+0.38	3.94	-0.56	4.75	-1.66	2.06	-1.75		
4,000	5.88	+1.03			3.02	-0.70	4.04	-1.70	1.75	-1.07		
4,500	5.23	+1.43			2.63	-0.54	3.86	-0.22				

TABLE 1.—Free-air temperatures, relative humidities and vapor pressures during July, 1928

TEMPERATURE (°C.)

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters)	
	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal	Mean	De-parture from normal
Meters												
Surface	27.4	+0.8	26.6	-0.5	21.3	+0.3	25.1	-1.5	25.1	+0.2	29.1	+4.3
250	27.2	+0.7	26.2	-0.5	20.7	+0.1	24.4	-1.3	24.9	+0.3	25.9	+3.0
500	25.2	+0.3	23.8	-0.4	20.7	+0.1	23.2	-0.7	22.6	+0.5	24.2	+2.7
750	23.9	+0.4	22.7	+0.1	18.8	-0.4	22.6	-0.2	20.3	0.0	23.0	+2.6
1,000	23.3	+1.2	21.2	+0.3	17.3	-0.7	21.7	0.0	18.3	-0.2	21.3	+2.3
1,250	22.4	+1.8	19.5	+0.3	15.9	-1.0	20.5	0.0	16.5	-0.4	19.3	+1.8
1,500	21.0	+1.9	17.9	+0.3	14.7	-1.0	19.2	0.0	14.9	-0.5	17.3	+1.3
2,000	18.2	+2.1	14.8	+0.5	12.1	-0.9	16.4	-0.1	11.9	-0.6	13.3	+0.3
2,500	15.2	+2.2	11.7	+0.5	9.2	-0.9	13.1	-0.5	8.5	-1.3	10.4	+0.2
3,000	12.0	+2.2	8.8	+0.5	6.1	-1.1	10.0	-0.7	7.8	+0.7	8.8	+1.2
3,500	9.5	+2.6	5.9	+0.6	3.1	-1.2	6.8	-0.9	5.2	+0.9		
4,000	7.0	+3.1			0.4	-1.2	3.8	-0.9	2.5	+1.0		
4,500	4.3	+2.9			-2.6	-1.7	0.7	-2.1				

1 Naval air station.

clouds at 1,400 meters. The highest vertical velocity observed was 3.2 m. p. s. between 750 meters and 1,100 meters. Another observation at the same station on the afternoon of the 27th showed an average vertical velocity of 2 m. p. s. from the surface to 1,715 meters where the balloon entered strato-cumulus clouds. The maximum vertical velocity was 2.9 m. p. s. between 1,250 and 1,600 meters.

The month was quite generally unfavorable for daily kite work. Flights at most stations were necessarily limited as to altitude and frequency because of light winds and the frequent occurrence of thunderstorms.

TABLE 2.—Free-air resultant winds (m. p. s.) during July, 1928

Altitude m. s. l.	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Greesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal		Mean		Normal	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Surface	S. 15 W.	5.4	S. 4 W.	3.2	S. 80 W.	2.3	S. 63 W.	1.1	N. 43 W.	0.8	N. 18 W.	0.3	S. 11 W.	3.7	S. 17 W.	3.6	S. 73 W.	3.0	S. 81 W.	1.5	S. 88 W.	0.9	N. 42 W.	0.5
250	S. 18 W.	5.6	S. 3 W.	3.3	S. 83 W.	2.5	S. 65 W.	1.2	S. 15 W.	5.5	S. 19 W.	4.4	S. 71 W.	3.3	S. 80 W.	1.7	N. 76 W.	3.0	N. 62 W.	1.5	N. 76 W.	3.0	N. 62 W.	1.5
500	S. 17 W.	6.9	S. 12 W.	4.8	S. 87 W.	3.7	S. 74 W.	1.9	N. 47 W.	0.6	N. 45 W.	0.1	S. 25 W.	7.8	S. 26 W.	6.2	S. 68 W.	4.9	S. 72 W.	3.1	N. 60 W.	4.4	N. 57 W.	2.2
750	S. 22 W.	7.8	S. 21 W.	5.2	S. 87 W.	4.0	S. 82 W.	2.2	S. 82 W.	0.7	S. 35 W.	0.9	S. 24 W.	8.1	S. 27 W.	6.4	S. 75 W.	5.7	S. 74 W.	3.9	N. 54 W.	4.4	N. 47 W.	2.7
1,000	S. 32 W.	8.0	S. 28 W.	5.1	N. 73 W.	3.7	S. 88 W.	2.4	S. 84 W.	0.9	S. 57 W.	1.3	S. 18 W.	8.1	S. 27 W.	6.1	S. 76 W.	6.8	S. 82 W.	4.5	N. 52 W.	4.8	N. 52 W.	3.0
1,250	S. 39 W.	7.6	S. 33 W.	4.8	N. 86 W.	4.8	S. 88 W.	2.8	S. 84 W.	1.4	S. 70 W.	1.8	S. 14 W.	7.1	S. 26 W.	5.6	S. 77 W.	6.8	S. 84 W.	5.3	N. 52 W.	4.8	N. 52 W.	3.0
1,500	S. 44 W.	7.0	S. 39 W.	4.5	N. 68 W.	4.6	S. 88 W.	3.7	S. 85 W.	2.5	S. 79 W.	2.6	S. 9 W.	6.5	S. 25 W.	5.1	S. 76 W.	7.8	S. 87 W.	6.2	N. 63 W.	4.9	N. 56 W.	3.9
2,000	S. 46 W.	6.4	S. 43 W.	3.8	N. 73 W.	4.2	N. 85 W.	5.2	N. 83 W.	4.2	N. 89 W.	4.0	S. 6 W.	5.0	S. 24 W.	4.2	S. 72 W.	8.4	S. 88 W.	7.4	N. 74 W.	5.6	N. 65 W.	4.7
2,500	S. 50 W.	5.1	S. 55 W.	3.8	N. 79 W.	5.9	N. 84 W.	6.4	N. 70 W.	5.7	N. 81 W.	5.7	S. 5 W.	4.5	S. 21 W.	4.0	S. 86 W.	9.1	N. 88 W.	9.7	N. 72 W.	6.0	N. 69 W.	5.8
3,000	S. 37 W.	4.1	S. 59 W.	4.1	N. 80 W.	7.2	N. 88 W.	7.9	N. 70 W.	7.8	N. 80 W.	7.5	S. 3 W.	3.8	S. 19 W.	4.1	N. 87 W.	10.3	N. 89 W.	11.2	N. 70 W.	7.8	N. 72 W.	7.3
3,500	S. 33 W.	4.8	S. 76 W.	4.4	N. 67 W.	8.0	N. 83 W.	8.3	N. 78 W.	10.0	N. 75 W.	10.1	S. 26 E.	6.5	S. 9 W.	3.2	S. 80 W.	11.5	S. 88 W.	10.8	N. 81 W.	8.1	N. 78 W.	7.9
4,000	S. 32 W.	5.5	S. 81 W.	5.3	N. 67 W.	7.2	N. 88 W.	7.9	N. 69 W.	15.7	N. 69 W.	11.5	S. 56 E.	5.4	S. 52 W.	0.9	S. 58 W.	11.2	N. 74 W.	9.7	N. 76 W.	6.8	N. 70 W.	8.2
4,500	S. 28 W.	5.9	S. 76 W.	7.2	N. 67 W.	8.0	N. 83 W.	8.3	N. 77 W.	18.3	N. 68 W.	13.7	E.	8.0	N. 25 E.	1.7	S. 67 W.	13.0	N. 62 W.	8.9	N. 70 W.	7.6	N. 82 W.	8.3
5,000	S. 28 W.	5.9	S. 76 W.	7.2	N. 67 W.	8.0	N. 83 W.	8.3	N. 77 W.	18.3	N. 68 W.	13.7	E.	7.0	N. 59 E.	3.5	S. 67 W.	13.0	N. 62 W.	8.9	S. 84 W.	7.2	N. 85 W.	8.2

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By P. C. DAY

GENERAL CONDITIONS

July, 1928, was notable mainly for the closeness by which the various weather elements approached the conditions expected in a normal midsummer month. A short period of unusual warmth occurred near the end of the month in portions of the far Northwest, but otherwise temperatures were moderate. Thunderstorms or other violent electrical disturbances were not unduly frequent as a rule, and damage by wind and hail, while considerable over limited areas, was, on the whole, less than usually occurs in July.

PRESSURE AND WINDS

A survey of the daily weather maps for July, 1928, shows few cyclonic areas of importance, and precipitation was mostly of the usual thunderstorm type, heavy in some instances, but these were confined usually to widely separated areas.

The most important cyclone of the first decade was observed on the morning of the 4th over the middle Plains, whence it moved to the vicinity of the lower Lakes during the following 24 hours, attended by considerable precipitation over the region traversed. By the morning of the 6th the low pressure had apparently moved toward the middle Atlantic coast and merged with a secondary depression that had developed during the preceding night over that region. The precipitation attending this depression was rather heavy over most of the coast districts from Pennsylvania to southern New England. During the 9th and 10th considerable rain fell over an extensive area from the Great Lakes southeastward to Florida, and to the eastward on the 10th and 11th, the falls being excessive in a few localities, Greenville, S. C., having about 4 inches in less than six hours.

By the morning of the 13th low pressure had developed over the southern drainage area of the Ohio, and widespread rains had fallen over most districts from the Mississippi River eastward. During the following 24 hours the barometric depression had moved to Lake Ontario and rain had spread into all eastern districts, with heavy falls over portions of the lower Lakes, Ohio Valley, and Middle Atlantic States.

About the 17th and 18th considerable precipitation occurred over the Southeastern States, though there was

no appreciable barometric depression at that time over the region of important precipitation. About the same time there was considerable precipitation over the northern Rocky Mountains and thence eastward to Lake Superior, the precipitation continuing over the western districts during the 19th and extending into the eastern lake region and North Atlantic States on the 20th and 21st.

Some local heavy rains occurred on the 21st and 22d from the middle and northern Plains eastward, the general barometric depression assuming a cyclonic form over southern New England by the morning of the 23d, more or less rain continuing over that region during the following day.

From the 26th to 28th a fairly well marked cyclone moved from western Lake Superior to the St. Lawrence Valley, attended by rather general precipitation over the Northern States from Minnesota to New England. At the same time local precipitation set in over the Gulf States, where some good rains occurred on the 26th and 27th.

Local precipitation occurred over the far Northwest during the first week, but otherwise there was little or no precipitation west of the Rocky Mountains.

Anticyclones were weak and exerted little important influence in modifying the weather over extensive areas or for lengthy periods. In fact, temperature changes were unusually small in all parts of the month and throughout nearly the entire country.

The mean pressure of the month did not depart greatly from the normal, and the pressure variations over the different parts were not sufficiently pronounced to cause important variations from the normal wind movement.

Local storms occurred, as is usual in midsummer, over the eastern two-thirds of the country, and they were rather frequent in portions of Nebraska, Iowa, and other near-by areas. No extensive loss of life was reported from tornadoes and damage from such storms was comparatively small. Full details concerning damaging winds, hail, and other storms appear at the end of this section.

TEMPERATURE

As stated elsewhere, there were no important variations in temperature as compared with the normal condition, though an unusually heated period occurred over portions of the far Northwest during the last decade. This was most severely felt over the eastern portions of Washington and Oregon, and in Idaho, where from about the 21st to